Gunnar Bastkowski

Programming with Categories

Yet another attempt to teach monads

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What is Category Theory?

Category Theory

S. Awodey approaches the term category theory as follows¹:

As a first approximation, one could say that category theory is the mathematical study of (abstract) algebras of functions.

Category theory addresses the question:

How can we combine functions to create new functions?



What is it good for?

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Theory

- Functional programming is about function composition
- Gives us tools to manipulate functions
- Provides a vocabulary like Design Patterns. But **much** more powerful

Vocabulary

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■ objects (A, B) and Arrows (f)

$$A \stackrel{f}{\longrightarrow} B$$

composition $(g \circ f)$

$$A \xrightarrow{f} B \downarrow_{g \circ f} \downarrow_{C} g$$

identity (id)

$$A \xrightarrow{id} A$$

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■ arrows compose For every $f: A \rightarrow B$

For every $f: A \rightarrow B, g: B \rightarrow C$, there exists a composition $g \circ f: A \rightarrow C$

associativity

$$(A \rightarrow B) \rightarrow C = A \rightarrow (B \rightarrow C) = A \rightarrow B \rightarrow C$$

• identity (id) For every A_1, A_2 , with A_1 equal² to A_2 ,

$$f_1: A_1 \to A_2 = f_2: A_2 \to A_1 = id$$



Challenges

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